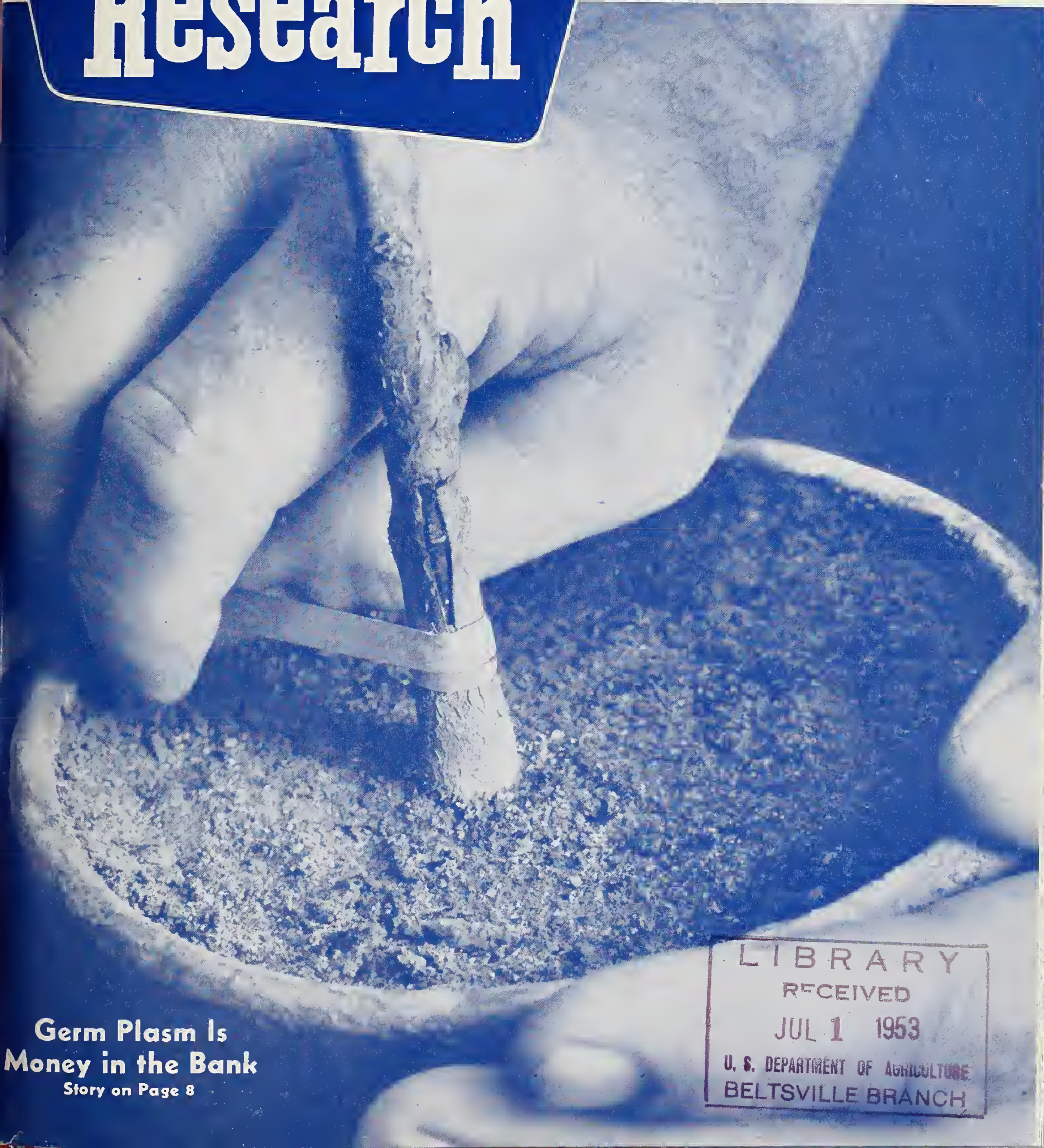
AGRICULTURAL Research

JULY 1953



Germ Plasm Is Money in the Bank

Story on Page 8

AGRICULTURAL

Research

VOL. 2—JULY 1953—NO. 1

THOMAS McGINTY—EDITOR
JOSEPH SILBAUGH—ASS'T EDITOR

Industry's Investment

The Secretary of Agriculture points out on page 4 of this issue that private industry spends an estimated $140 million a year for agricultural research, or at least 30 percent more than the State experiment stations and the USDA combined. This estimate is based on figures supplied by the Department of Defense, the Department of Labor, and the National Research Council, plus additional data collected by USDA.

About $50 million of industry's yearly investment is in direct aid to agricultural and forest production. It includes more than $20 million for farm-machinery development and about $25 million for research on agricultural chemicals. The remaining $90 million pays for development of new and improved agricultural products and methods of handling them. This amount includes about $41 million spent on food and related products, $36 million on forest-products research, and $12–13 million on natural-fiber textiles, tobacco, and other products.

These figures represent a conservative estimate of the outlay of industry for agricultural research related to products and processes in which it has a direct commercial interest. But industry's total contribution probably adds up to a considerably higher figure. It includes some $6 million a year in grants to State agricultural experiment stations, about $2½ million in cash contributions to USDA research, plus land, facilities, materials, and services worth several millions more, which are made available to public research agencies.

It is difficult to put a cash value on industry's stake in publicly sponsored agricultural research, but it is unquestionably great. Fundamental research by USDA and State scientists provides knowledge and germ plasm for private seedsmen and plant and animal breeders, who in turn develop commercial varieties of crops and improved breeds of livestock. Research projects conducted jointly by industry and the State and Federal governments number in the thousands.

As Secretary Benson says, this cooperation has been essential to farm progress. By working together, industry and government make possible the rapid, widespread adoption by farmers of new techniques. Industry, agriculture, and the general public all benefit from this teamwork.

AGRICULTURAL RESEARCH ADMINISTRATION
United States Department of Agriculture

BUDDING foreign tree fruits to our own root stocks is one way we build up and preserve valuable breeding material at the national plant bank described in the picture story on pages 8 and 9 of this issue. *USDA photo by Forsythe.*

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Anniversary for Aerosols

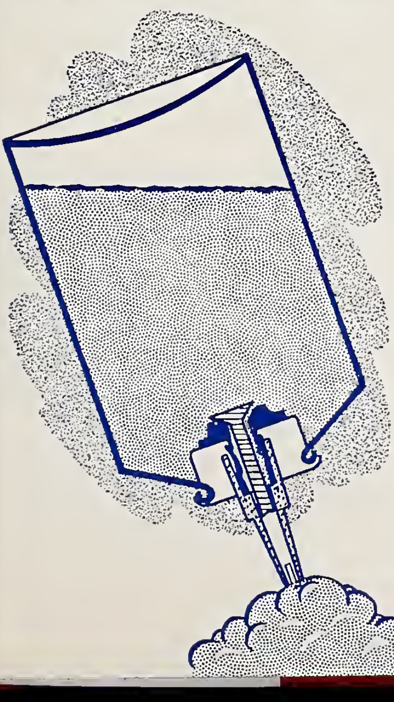
Aerosol bombs, carried around the world by servicemen to battle bugs during World War II, were patented just 10 years ago. The anniversary finds aerosols on the market in dozens of new forms, with yearly production running into millions of cans.

Scientists in the Bureau of Entomology and Plant Quarantine worked out in 1941 a way to combine insecticides with liquefied gas to make a self-propelled spray. Such a solution, escaping through a small hole, produces a mist so fine that the microscopic particles of insecticide stay suspended in the air.

This research resulted in a public-service patent, assigned to the Secretary of Agriculture in 1943. The Department issues royalty-free licenses to qualified manufacturers of insecticide aerosols.

Industry saw wide possibilities for the aerosol bomb, but the high vapor pressure required a heavy container—too costly for everyday products.

The break came in 1947, when Bureau scientists, in cooperation with can and chemical manufacturers, devised a new low-pressure bomb using a mass-produced, beer-can-type container. Now aerosols are not only safe, efficient, and easy to use—they're inexpensive as well.



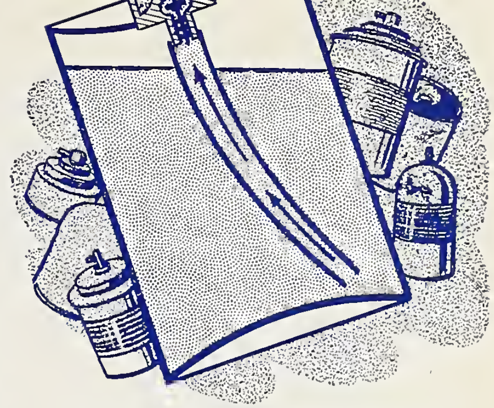
Producing this simple package is a precision job, says aerosol specialist R. A. Fulton. The valve, for example, is machined with greater exactness than the parts of a watch, to insure proper spray-particle size and to avoid leakage.

Each type of bomb is tailor-made. Valve, container, propellent, and active ingredient are carefully combined to dispense the contents in just the right way. Even a small change in formula could upset the balance.

In most cases, the aerosol propellent is a fluorinated hydrocarbon, also used in refrigerators. This is a liquid at low temperatures and usually is put into the container under refrigeration. At ordinary temperatures, part of the liquid changes to a gas and fills up the head space in the can. This provides the pressure that makes the bomb work. When the valve is opened, more liquid changes to gas and maintains pressure in the can till all the contents are used.

In space-spray aerosols, such as those used for insecticides and room deodorants, propellent and active ingredient are in solution. The surface-coating sprays operate on a similar principle. In this group are paints, waxes, moth-proofers, cosmetics, weed killers, lubricating oils, and many other products.

In foam aerosols, the propellent is partly emulsified with the active ingredient. The gas whips this material into a foam as it comes out of the nozzle. We now have whipped cream, pancake batter, shaving cream, and shampoos in aerosol form.



One of the outstanding uses of aerosols is in greenhouse pest control. They distribute insecticides more effectively than spraying or dusting, do the job with less material, and take only a fraction of the labor.

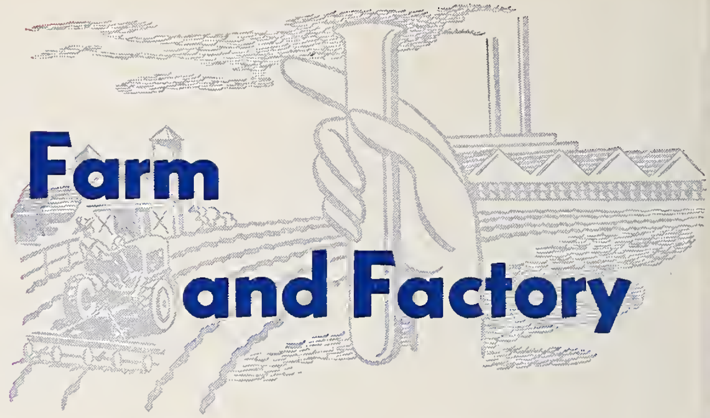
Rose growers, for example, get striking summer increases in production by using this method to control spider mites. In one greenhouse, water sprays not only took 28 man-hours to apply but also increased blackspot infection and leaf loss. Aerosol treatment took one man 15 minutes and was ideal for the roses.

Insecticide bombs help us deal with disease-carrying insects that come into the country by airplane. Bureau scientists recently helped the Navy devise a built-in aerosol system to treat an entire aircraft instantly.

The entomologists have continued testing and research for the armed forces, which helped support the original work and were among the biggest aerosol buyers. Late developments include permanently leak-proof, hermetically sealed bombs.

Other work has brought refinements in package, ingredients, and filling technique. But one of the most important jobs of the Bureau's aerosol specialists is the testing involved in licensing makers of insecticide bombs. Many points must be checked, from formula and particle size to valve and container, to make sure buyers get a safe, effective product.

The research challenge to Farm and Factory



by Ezra Taft Benson
Secretary of Agriculture

Industry's investment in agricultural research today surpasses that of the State and Federal Governments. Secretary Benson calls for increased cooperation between public agencies and private industry in the big research job still facing agriculture. This article consists of excerpts from an address given before the Institute of Animal Agriculture at Purdue University on April 21, 1953.

AGRICULTURAL research has been the basis for a doubling of over-all efficiency in farm production during the past 50 years. Moreover, it has constantly fed new ideas to industry for adaptation and development. and it has given great impetus to our growing knowledge of human nutrition and health. But if agricultural research has contributed greatly to industry and to the national welfare, so also has industrial research contributed immensely to agriculture.

Industry, in fact, now spends more on agricultural research than government does. Perhaps this comes as a surprise to many of you. Yet estimates indicate that industry spends \$140 million a year for research on agricultural products and on machinery and materials used in agriculture. Public expenditures for agricultural research, both State and Federal, total \$107 million.

I salute industry for its tremendous investments in research, which have helped to make our farmers and agriculture generally the most efficient and prosperous in the world.

While it will always be necessary to have public agricultural research—and I feel sure that we must expand public support for such work as we move into the future—there are many phases of this effort that can be handled by private industry.

Cooperation between industry and government in agricultural research is good. But we can make it better. Surely there is a way for us to develop a better exchange of information. We all want to prevent unnecessary duplication of effort.

How can we get the results of research of large industries made available to small businesses that cannot conduct their own research? If this problem could be solved, Government could devote more of its attention to fundamental research and less to applications of basic knowledge.

I am told by the National Research Council that most research done in industry is applied research, as contrasted with fundamental or basic research. This is understandable—there is constant need to improve old products and develop new ones.

As in industry, applied research has claimed most of the resources of the Department and of the State experiment stations. Again this is understandable. Public bodies appropriate research funds in response to demands from citizens, and most of these demands are related to emergencies. A new livestock disease, or a threatened invasion of new territory by a dangerous insect or by a plant disease calls for immediate action. However, much time is lost in seeking answers by trial-and-error methods, when they might be found quickly if we had discovered the basic principles that underlie the practical applications we are seeking.

Industry has a large stake in basic research. I wonder, therefore, if private industries cannot do more than they are now doing to support basic research through grants to universities. Many corporations are already following this practice. It would be a good thing for industry and the entire Nation if it could be expanded. Despite the progress we have made, we still have far to go before our

agriculture will be truly efficient.

About 85 percent of our total farm production is now used for food, feed, and fiber. We have no exact figure on the percentage that goes to industrial uses, but it is very low, probably between 2 and 3 percent. Even a small increase in industrial uses could exert profound influence on demand for commodities used by industry. We expect to strengthen research of the Department of Agriculture aimed at developing new uses for farm products and byproducts. I feel sure that industry could profitably increase its investment in this field.

We also need to do more on nutrition education. If farmers and the dairy industry could team up to recapture the market for the 130 pounds of milk per person which has been lost during the last thirteen years, they could turn our milk surpluses into scarcities.

If everyone followed the recommendation of nutritionists—that we should each use 5 quarts of milk a week—we would be consuming one-fifth more milk than we do now.

I mentioned earlier that in the past 50 years we have doubled the overall efficiency of our farm production—largely through research. I say to you now that we have an even harder job ahead of us.

We are a growing Nation. But we are already using almost all of our good land, and the number of people in agriculture is going down. In 1910, when our national population was 92 million, there were 12 million persons actively engaged in agriculture. By 1975 our population is expected to be at least 190 millions. But if the long-term trend continues, there may then be only 9 million persons actively farming.

That is the challenge to research.

My desire is that we pool our efforts in the best possible manner, to get the most for every research dollar invested. The research of today shapes the welfare of our country tomorow—and, indeed, the welfare of all free peoples everywhere. Truly, knowledge pays the best interest.

The benefits of past cooperation between industry and agriculture are readily apparent:

—In 10 years' time, industry and agriculture, working together, put hybrid corn on farms.

—In 10 years, working together, industry and agriculture doubled the use of fertilizer.

—In 15 years, industry and agriculture, working together, largely accomplished the miracle of farm power mechanization.

My friends, I challenge you to make the record of the future twice as good as the record of the past.

Research workers are honored at USDA award ceremony

At the Department of Agriculture's sixth annual Honor Awards Ceremony on May 19, Secretary Benson presented 24 individual and 4 unit awards to employees of the Agricultural Research Administration.

A total of 127 awards were made this year in recognition of outstanding accomplishment by USDA personnel throughout the United States. ARA workers won eight of the nine Distinguished Service Awards presented. The recipients:

Dr. Fred C. Bishopp, Bureau of Entomology and Plant Quarantine—for organizing, conducting, and directing research that has resulted in the development of effective methods of controlling plant pests.

Dr. Sterling B. Hendricks, Bureau of Plant Industry, Soils, and Agricultural Engineering—for contributions to fundamental knowledge in the field of physical and organic chemistry, soil science, physics, and plant physiology. (See p. 14.)

Dr. Allene R. Jeanes, Northern Regional Research Laboratory, Bureau of Agricultural and Industrial Chemistry—for pioneering chemical research on dextrans and contributions to research for national defense that expedited development of blood-plasma substitutes from dextrans. (Agr. Res., Jan.–Feb. 1953, p. 15.)

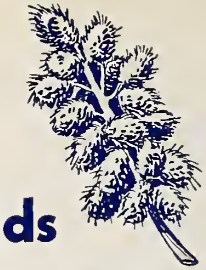
Dr. Henry A. Jones, Bureau of Plant Industry, Soils, and Agricultural Engineering—for research on the genetics of cytoplasmic male sterility in plants and development of methods for its application to commercial production of F_1 hybrid seed.

Ernest R. Sasscer, Bureau of Entomology and Plant Quarantine—for leadership in USDA activities against the entry and spread in the United States of plant pests. (Agr. Res., May–Jun. 1953. p. 7.)

Dr. R. W. Trullinger, Chief, Office of Experiment Stations—for vision and leadership in research administration that has fostered strong Federal-State relationships and aided in the achievement of an efficient, well-coordinated total agricultural research program.

Animal Fat Oxidation Unit, Eastern Regional Research Laboratory, Bureau of Agricultural and Industrial Chemistry—for research that led to large-scale development of epoxidized products from inedible animal fats for use in plastics. (Agr. Res., Mar.–Apr. 1953, p. 15.)

Project on the Action of Diisopropyl Fluorophosphate (DFP) on Esterolytic Enzymes, Western Regional Research Laboratory, Bureau of Agricultural and Industrial Chemistry—for contributions to basic knowledge of enzyme activity, significant to the defense effort and to agriculture, through discovery of how the war gas DFP and related insecticidal analogues inhibit certain enzymes.



Hybrids boost *Castorbean* yields

New, high-yielding castorbean hybrids will be ready next spring for many farmers to plant in the Southwest. They are first products of research that may well lead the versatile castorbean to a high place among U. S. oilseed crops.

Information on how to grow the hybrid seed has gone out to interested seedsmen. Oklahoma and Texas Seed Stock Foundations have been supplied with seed of the female parent line. Male parents of the new hybrids include the best inbred varieties now grown. A quick build-up of hybrid seed is expected, and some will be available for 1954 planting.

These hybrids were developed by ARA plant breeders in cooperation with the Nebraska, Oklahoma, and California Agricultural Experiment Stations. In field tests last year they demonstrated their value by yielding 15 to 20 percent more beans per acre than present commercial inbreds.

Production of successful castor hybrids now appears easier than was thought possible a few years ago. Breeders look forward to still better hybrid combinations—more resistant to drought and disease, easier to harvest by machine, and giving even higher yields per acre.

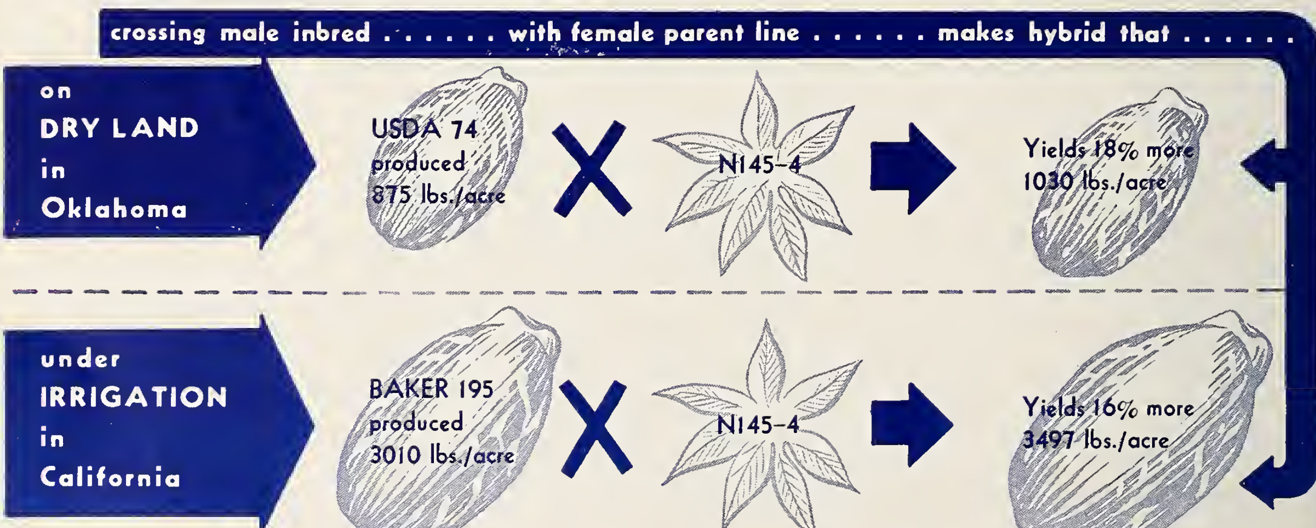
The key to present hybrid castorbeans is a male-sterile line known as N 145–4. It was discovered at the Nebraska experiment station in 1950 by C. E. Claassen and Albert Hoffman. About half the plants it produces are pollinating types, and the rest are female, or male sterile.

To make the new hybrids, seed is harvested only from these 100-percent female plants. It is then grown with a good inbred variety, which serves as the pollinator. The first-generation (F_1) seed of this combination provides the hybrid stock that farmers will plant, much as they do the seed of hybrid corn.

When N 145–4 was discovered, breeders thought that only special combinations with it would produce successful hybrids. But D. L. Van Horn and L. H. Zimmerman of the Bureau of Plant Industry, Soils, and Agricultural Engineering found that practically any good inbred strain with N 145–4 makes a hybrid that yields better than its parents. They caution growers, however, to avoid male parents that may produce easily shattering hybrids, unsuited for mechanical harvesting. The chart and legend below summarize their results with some of the new hybrids.

Castor oil is unique in chemical structure and readily convertible to compounds industry can use. Its hundreds of applications—many important to defense—include jet-engine lubricants, hydraulic fluids, paints, plastics, and textiles.

It is the main source of sebacic acid, essential in making nylon and various



USDA 74 is a leading castorbean inbred variety for dry-land cultivation. Baker 195 is the preferred semidwarf inbred for irrigated land. Three other inbreds and their hybrids with N 145–4 gave these results: In Oklahoma—Cimarron, 838 lbs. of beans per acre; its hybrid, 1,009 lbs. USDA 101, 808 lbs. per acre, its hybrid, 1,066 lbs. In California—USDA 250, 3,308 lbs. beans per acre; its hybrid, 3,936 lbs.

plastics. Dehydrated castor oil—a chemical modification—goes into high-grade varnishes, enamels, and electrical insulation. The sulphonated oil is used in dyeing fine fabrics. Medicinal use, for which castor oil is best known, accounts for only a minute fraction of total consumption.

Imports and domestic production now give the United States about 170 million pounds of castor oil a year. Most of it comes from beans imported from Brazil and India. If industry had an assured supply of first-quality oil at a suitable price, demands for it would undoubtedly increase.

The castorbean has had an on-again-off-again history in United States farming, going back to about 1870. The Government encouraged its cultivation during both World Wars. Since 1951, at the request of the Munitions Board, the USDA has conducted a program to increase domestic castorbean production. Farmers with program contracts this year are guaranteed 9 cents a pound for hulled beans.

They are expected to harvest about 125,000 acres in 1953, which should yield about 40 million pounds of castor oil and twice that amount of beans. With the new hybrids, chances are that U. S. acreage and yield of oil will both increase in 1954.

Hardier alfalfa

Vernal alfalfa, a superior new variety for northern areas, will get a fast buildup in the National Foundation Seed Project. Farmers should be able to buy some seed by 1956.

Vernal is even more winter hardy and resistant to bacterial wilt than the popular Ranger variety.

The Wisconsin Experiment Station and the Bureau of Plant Industry, Soils, and Agricultural Engineering cooperated in breeding Vernal. The Utah Experiment Station produced a supply of breeder seed.

High humidity means better rice milling

Finding a way to control relative humidity in rice milling could mean less breakage of the grain and bigger yields of premium quality rice, according to recent studies at the University of Arkansas.

In a contract project supervised by ARA's Bureau of Agricultural and Industrial Chemistry, Arkansas researcher H. S. Autrey found that yields of head rice, or unbroken kernels, average about 5 percent greater when relative humidity is high (70 to 80 percent) than when atmospheric conditions are fairly dry (30 percent relative humidity).

Increasing mill yields of head rice is important, since unbroken grain brings about 5 cents a pound more at wholesale than the next best grade of rice, which has some broken kernels. But no means has yet been devised to maintain optimum humidity during the milling operation.

The basic process of rice milling has remained virtually unchanged for 50 years or more. But the Arkansas studies—particularly the finding that relative humidity has a marked effect on head-rice yields—may foreshadow fundamental alterations in present milling methods.

Varieties used in the tests were Bluebonnet, Rexark, and Zenith. About 27 percent of milled rice produced from these varieties is broken grains. The rice contains about 9 percent broken kernels when received at the mill, and an additional 18 percent is normally broken during milling. The Arkansas experiments show that four-fifths of this breakage occurs in removing the final 25 percent of the bran coat from the rice kernels.

The trials also demonstrated that steaming of rice before milling, and use of abrasives in the milling process, greatly increases the capacity of rice-hulling equipment. But these measures contribute only slightly to increased yields of head rice, except in the case of rice having bran that clings more tightly than usual to the kernels.

Steaming alone increased huller capacity 10 to 25 percent. Abrasives added to the unmilled rice permitted the hullers (which remove the bran) to handle 20 to 30 percent more rice per hour. When steaming and abrasives were used together, the capacity of the huller was increased as much as 40 percent.

Rice-crop facts

Rice is grown in the U. S. on just under 2 million acres in 5 States—Louisiana, Texas, Arkansas, California, and Mississippi. Rough-rice production is about 4 billion pounds a year, with a farm value of $200 million. Our rice harvest is not large compared to that of China or India, and we rank second among Western Hemisphere producers (Brazil grows about 6 billion pounds a year). But the U. S. is the world's third largest exporter of rice (after Thailand and Burma). Our production of milled rice is about 2.5 billion pounds annually, more than half of which is exported. We consume about 5½ pounds of rice per person per year.

Fits well, too

Louisiana rice growers are trying a new variety this season—Sunbonnet. It was developed by N. E. Jodon, USDA agronomist, and C. N. Bollich of the Louisiana Experiment Station. Tests show that it should excel the widely grown Bluebonnet in yield per acre and perhaps in mill yield of whole kernels. Sunbonnet also gives better stands and has higher resistance to a leafspot disease of rice.

Banking the world's *Plant Treasures*

ONE keystone of American agriculture is a bank—a living storehouse of 200,000 of the world's plants.

Among its deposits are new food crops, raw materials for industry, and drugs for medical science. Even more important, this storehouse is giving research men the breeding stock they need to improve all our crops.

To find many of the bank's treasures, American plant explorers venture into the wildest parts of the earth. Items come also from foreign scientists and our own missionaries and business men abroad. Every year, thousands of new materials arrive at Plant Industry Station, Beltsville, Md.

Here, under C. O. Erlanson, the Division of Plant Exploration and Introduction begins the big job of screening, cataloging, and preserving these plant stocks, for use in years to come.

Plant introduction is an old story for the New World, because not one of our major crops is native to this country. The Indians brought in corn, tobacco, pumpkins, squash, and beans from tropical America. From the same area came tomatoes, cotton, and potatoes. Our cereals, soybeans, alfalfa, timothy, clover, and our common vegetables all originated in Europe and Asia.

Organized plant introduction has grown with the upsurge in breeding that began about 1900. Scientists found that the right plant parents can give us hybrids with strength to resist weather, disease, and insect hazards. To find such parentage—breeders think of it as germ plasm—we must have plenty of breeding material.

Our search for stock led to primitive sources. Here, withstanding natural hazards for thousands of years, plants have built up immunity or resistance. Modern breeding techniques transfer

Plant stocks are built up and screened

then preserved for future breeding work

GERM PLASM from around the world comes to us in the form of seeds and plants, cuttings and runners, bulbs and tubers. This material is inspected and fumigated (above) at District of Columbia plant inspection house to make sure no insects or diseases are brought in. Samples then go to Federal and Regional Plant Introduction Stations for buildup and screening, often under quarantine.

ese qualities into healthier, hardier, ıd more productive crops.

One gain after another has been re- rded by our germ-plasm bank: The llion-dollar soybean crop goes back introductions from the Orient. Acala tton was found in a sun-baked field in exico. We have the navel orange om Brazil, Ladino clover from Italy, ıd many others.

Many plants have no crop value for is country, yet carry resistance we ed. We're fighting stem rust with ıeat strains from Egypt and Kenya. ıstralia gave us rust-resistant oats, veetpotatoes from Tinian Island provided resistance to stem rot. These are only a few of many examples.

When new stocks arrive in this country, inspection and sanitary treatment come first. Some samples go to Glenn Dale (Md.) Introduction Station for growing in quarantine. Other stocks are sent to regional introduction stations at Experiment, Ga., Ames, Iowa, and Pullman, Wash. These stations, cooperative with State experiment stations, furnish samples to breeders, coordinate screening, and see that stocks are preserved.

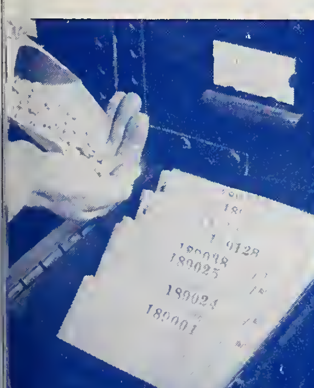
Potatoes go to the National Potato Introduction Station at Sturgeon Bay, Wis. Much of the work on new crops and on tree fruits and ornamentals is carried on at Glenn Dale and other Federal stations at Savannah, Ga., Coconut Grove, Fla., and Chico, Calif.

Another important job is to preserve samples of crop plants we already have. Scientists need them to check the purity of old varieties and to breed new ones.

In recent years, paying as well as receiving has become an important function at the germ-plasm bank. With other nations expanding their breeding work, the plant specimens that come into the United States now pass others that are outbound all over the world.

Field Crops

Stocks are built up at introduction stations, which ask State experiment stations to help screen the material for the use of breeders. Great care must be taken to keep stocks pure.



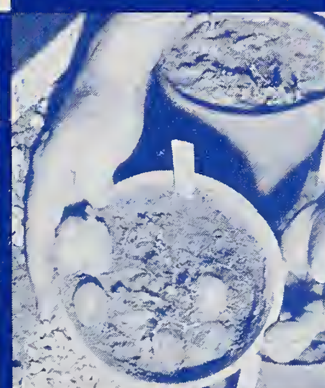
Some plants can be held as seed for long periods in a low-temperature, low-humidity room like this. Otherwise, frequent replanting may be necessary to keep stocks fresh.

Tree Fruits

Most tree fruits come in as cuttings which are budded or grafted to root stocks. After a 2-year increase in quarantine, budwood is then distributed to breeders in State stations.

Living banks of germ plasm for tree fruits are maintained at Federal Introduction Stations so stocks will be available for future work. Seed of tree fruits will not breed true.

Potatoes



Foreign potato samples get a quick buildup under quarantine at Glenn Dale. These small seed tubers then go to the National Potato Introduction Station at Sturgeon Bay, Wis.

After screening and building up the stocks, Sturgeon Bay holds them for future breeding use. This generally means replanting every other year to keep potatoes in good condition.

Specialties

These cortisone-producing yams introduced from tropical America will be started at Glenn Dale. Such valuable specialties go to other stations for buildup and preservation.

Ornamentals are released if they show promise. Azaleas from Japan and China were used in breeding the famous Glenn Dale hybrids. Most ornamentals are not held long.

The right POTATO makes good CHIPS

Making good potato chips is easy—if you put the right kind of potatoes into the fryer. That's the trick.

Finding such potatoes is worth some trouble, because the growing chip industry now uses 25 million bushels of potatoes and 60,000 tons of vegetable oils every year.

The chipper must put out an attractive product: light golden brown, crisp, and not too oily. Oiliness also is important from the standpoint of cost, since fat accounts for 30 to 40 percent of chip weight and is more expensive than the potatoes themselves. Then there's the matter of yield, which may vary from 20 to 30 pounds of chips from a 100-pound bag of potatoes.

Success lies mainly in choosing suitable varieties and in properly growing, harvesting, and handling the stock, say R. C. Wright and T. M. Whiteman of ARA's Plant Industry Station, Beltsville, Md.

The potato, they point out, is a natural chemical factory. Using its chlorophyll to pick up energy from the sun, the potato plant makes simple sugars out of carbon dioxide and water. These sugars are transformed into starches and stored in the tuber. It's late in the growth period that the starch buildup is heaviest.

Research has shown that high starch content usually goes along with high chipping quality, which means potatoes must be mature to make the best chips. Yet, modern spraying practices keep the vines alive longer, and potatoes must often be dug before their starch buildup is complete. Such potatoes are likely to make chips that are too dark.

If they're allowed to mature, all varieties of potatoes make good chips for 2 or 3 days after digging. Later, some varieties become worthless for chipping, even under the most favorable conditions. In many cases, however, it's storage that counts.

The usual practice is to store potatoes at 40° F. to keep them from sprouting. But the tuber is still operating as a chemical factory and finds this temperature ideal for turning starch back into sugar within a few days. Research, principally at the Colorado and Cornell Experiment Stations, indicates that certain amino acids in potatoes join with the sugars, causing the chips to cook dark and taste burned and bitter.

Fortunately, this reaction inside stored potatoes works both ways. A reconditioning period at about 70° F. for 1 to 4 weeks will de-sugar many varieties so they will again make light-colored, marketable chips.

Storing potatoes at 50° to 55° F. keeps up the starch level and maintains good chipping quality. Sprouting isn't troublesome at this temperature for 3 to 5 months. Chippers who control their own stock usually store part of the crop at this higher temperature and part at 40° F. for later reconditioning.

For the chipper who buys stock on the open market, late winter through spring is a critical time. Old-crop potatoes have been stored all winter at low temperatures and new stock from the South has been dug before it matured. Some chip makers are growing their own potatoes in the South to make sure of having properly matured stock for early-season use.

Scientists have found that chipping quality can usually be measured in terms of specific gravity. That is, the heaviest potatoes of any variety make the best chips. Specific gravity increases as potatoes mature and is highest when starch content is at a peak. At this time, also, chip yield is highest, oil uptake lowest, and color most desirable.

Cornell researchers find that a specific-gravity increase of .005 means an extra pound of chips from 100 pounds of potatoes. If potatoes of 1.060 specific gravity sell for $4 a bag, they figure, a bag rating 1.085 is worth $6.50 to chippers.

Eventually, we may have a practical way for chip makers to skim off the lighter potatoes and use only the heavier ones.

In the meantime, chippers should buy only the most dependable varieties. At Beltsville, Wright and Whiteman recently completed trials on 11 varieties to see if they could be reconditioned to make good chips after several months of low-temperature storage. This makes a total of 44 varieties tested in the last few years. Most, but not all, are now commercially important in the U. S. Here's how some of them rated:

Outstanding — Canus, Chippewa, Kennebec, Rural New Yorker, Russet Burbank, Russet Rural, and Sebago.

Satisfactory—Cherokee, Irish Cobbler, Katahdin, and Progress, and the newer varieties Chisago, Satapa, and White Cloud.

Unsatisfactory — Green Mountain, Houma, LaSoda, Menominee, Mohawk, Ontario, Pontiac, Red Warba, Sequoia, Triumph, Warba, Waseka.

Our first *Virus-free* strawberry plants

Strawberry growers can look forward to a new research product promised for next spring—virus-free plants. Nurseries will offer them in 1954 for the first time. Only then will we begin to learn just how much strawberry virus diseases have cost.

These diseases have spread until there's hardly an uninfected strawberry plant in the country—outside new ones now in nurseries. But most people haven't paid much attention to the virus, because there's usually nothing to see—no leaf spots or distorted leaves or abnormal fruits. Plants known to be infected look as healthy as others, generally because the others are infected, too. Strawberry virus—a complex of plant viruses—is just accepted as normal.

ARA scientists and many growers now believe, however, that viruses really put a low ceiling on strawberry production. They weaken the plants, cut runner formation, and hold down berry yields. Infected plants never recover. The viruses spread to all parts of the plant and pass through runners to daughter plants. Strawberry aphids, feeding on the young leaves and stems, carry the disease from plant to plant, from one field to another. Although some strawberry varieties tolerate virus better than others, none seems to be immune.

The situation looked nearly hopeless, but ARA horticulturist G. M. Darrow and his associates had a plan. At the Plant Industry Station, Beltsville, Md., they set out to find a single uninfected plant of each commercial variety. From such plants—if they existed—the researchers hoped to build a whole new virus-free strawberry population.

Berry growers, nurserymen, and scientists around the country sent to Beltsville hundreds of the most vigorous plants to be found. Tests showed nearly all these plants were infected. But among them were a few of the rare, virus-free plants the researchers had hoped to discover.

The Beltsville work has turned up virus-free plants of 34 varieties. Six more were found at the Oregon Experiment Station. At least 96 percent of U. S. strawberry acreage is planted to these 40 varieties.

The scientists carefully saved runners from their uninfected plants and soon built up several hundred new plants in field plots. These plantings were separated from other strawberries and dusted with parathion for aphid control. They stayed virus free.

There were enough stocks of 11 varieties to send to cooperating nurseries in 1952. They agreed to isolate and dust the plants and sell half their stock to other nurseries this year. More than 100 acres are now in virus-free stock. They should produce 15 to 20 million plants for use next spring. Varieties include Klondike, Klonmore, Tennessee Beauty, Tennessee Shipper, Marshall, Blakemore, Howard 17 (Premier), Massey, Sparkle, Tennessean, and Catskill.

Growers can keep virus out of these plants. First, they should be set as far away from other berries as possible. Second, both virus-free and infected plantings should be dusted with parathion in the spring and in the fall, when aphids are out in force. Finally, all nearby wild strawberry plants should be dusted with parathion or given a dose of weed killer, since they are likely to be a source of virus infection.

The researchers believe this care will be a low price to pay for up to two or three times as many runner plants and bigger crops of better quality strawberries.

VIRUS test of a plant is made by grafting it to a virus-free plant of the wood strawberry, *Fragaria vesca* (right), which shows the effect of viruses more quickly and clearly than commercial varieties. If the Klondike plant (left) has a virus infection—from one or a combination of virus types—it can be easily distinguished in the *Fragaria vesca* plant within a few days.

Streptomycin *Cures* halo blight

HALO-BLIGHT, bacterial disease of beans, severely stunted the plant at left. Center plant, also blight infected, was given streptomycin soon after symptoms appeared. It recovered and did almost as well as uninfected plant at right.

Antibiotics, already known to prevent halo blight of beans, may also cure plants that are infected with this bacterial disease.

ARA research has shown that streptomycin sulfate protects beans from halo blight when applied before the plants become infected. (AGR. RES., Mar.–Apr. 1953.) Now, greenhouse experiments by W. J. Zaumeyer, J. W. Mitchell, and W. H. Preston prove that streptomycin, applied in time, can cure plants after infection.

These scientists inoculated bean plants with the halo-blight bacteria. Disease symptoms appeared 2 or 3 days later. Then, within several hours, the tops of some plants were dipped in a water solution of 0.025 percent streptomycin.

Blight soon spread through the untreated beans. In these plants the bacteria, together with the toxins they produced, caused yellowing of the leaves and stunted the plants severely. But the blight spots on the leaves of the dipped plants cleared up after several days, and the beans resumed their normal growth.

Apparently, leaf cells absorbed the antibiotic, which then killed the bacterial blight organisms in and between these cells. The scientists found, however, that streptomycin gave no control when treatment was delayed until several days after the appearance of blight symptoms.

Large-scale field tests are now under way at the Plant Industry Station, Beltsville, Md. Bean plots showing different stages of halo-blight infection will be sprayed with both streptomycin and terramycin, from once to several times, to determine whether the disease can be cured in the field. If results of these experiments confirm the greenhouse findings, it is possible that blight losses can be reduced by spraying infected fields with antibiotics before the disease has gone too far.

Refrigeration and sprinkling makes for livelier lemons

There's new shelf life for lemons in one of the latest ARA studies on handling fruits and vegetables.

The common practice among retailers has been to display lemons in dry racks at room temperature. Tests at the Plant Industry Station, however, showed that lemons really need refrigeration and sprinkling to keep them fresh and attractive.

When horticulturist W. E. Lewis held lemons at room temperatures for a week or more, the skin dried out, the fruit shrank and got soft, and the button became discolored.

On the other hand, display in either an ice-bed case or a mechanically refrigerated case gave excellent results. These methods held the fruit temperature at 37° to 42° F.

The retailer who doesn't have such equipment can keep lemons in good shape by taking them off his nonrefrigerated rack and storing them under refrigeration at night. This practice brings the average daily temperature of the lemons down to about 50°, the tests showed.

Sprinkling reduced weight and size losses, especially in fruit that was not kept under refrigeration.

Results of this and other shelf-life studies indicate that retailers should not use false-bottom racks in refrigerated cases unless the produce moves out rapidly. Such racks raise the

displayed produce above the cool-air source, causing temperatures to run 15° to 20° higher.

Details of the study are in a report available from W. T. Pentzer, Plant Industry Station, USDA, Beltsville, Md. (For related work, see AGR. RES., Mar.–Apr. 1952, p. 12.)

Fresher mushrooms

Mushrooms need refrigeration—in shipment and storage and on retail display. Some grocers may be missing a good bet by not putting mushrooms in refrigerated display cases. Tests at the Beltsville (Md.) Agricultural Research Center show that freshly picked mushrooms stay in perfect condition for only 1 day or less at 60°–70° F., but will keep for 1 to 2 days at 40°, or 4 to 5 days at 32°. They can be stored for 3 to 4 days at 32° F., or 2 days at 40°, and still remain in good selling condition for one day, if displayed in refrigerated show cases at 50° F.

Cool at less cost

A California-New York transit test has yielded money-saving answers for grape growers and railroads.

The study showed that refrigerator cars equipped with a new-type overhead electric fan will hold transit temperatures as well as cars with the regular floor-type fan. Over-head fans are cheaper to install, work more efficiently, and are less apt to get clogged with dirt.

ARA research men also tested half-stage icing—that is, raising grates half-way up in car bunkers and using only half a load of ice. This was sufficient for precooled grapes and saved about $27 a car.

Details are given in Handling, Transportation, and Storage Report 288, available from W. T. Pentzer, Plant Industry Station, U. S. Department of Agriculture, Beltsville, Md.

Targhee —a good range breed

The same scientific breeding that put Targhee sheep on western ranges, to meet a special need of wool and mutton growers, now points to further improvement of this young breed.

The Targhee is an "intermediate" breed, developed at the U. S. Sheep Experiment Station, Dubois, Idaho, in cooperation with a dozen sheep-raising States. In size, type, and fineness of wool, it fits between the smaller, fine-wool breeds and the larger, white-faced crossbreds. The Targhee was carefully planned that way for the vast range areas where grazing, too, is intermediate—with more forage than small sheep require, but not enough for larger breeds.

In the Targhee's ancestry, fine-wool sheep predominate (particularly the French Rambouillet, with some blood of the Spanish Merino). But the line also includes about one-quarter coarse-wool blood from the English Lincoln, which helps account for the good quality of Targhee mutton.

By continued selection and crossing, breeders now seek to further improve the Targhee's meat and wool quality, while retaining in the breed its hardiness, medium size, and good adaptation to the range.

Until about 1900, says D. A. Spencer of ARA's Bureau of Animal Industry, sheep were produced in the U. S. mainly for wool. Western ranchmen chiefly raised the fine-wool breeds, such as Rambouillet and Merino. But during the past 50 years a growing market developed for lamb meat. Ranchmen adjusted to this demand by crossing fine-wool ewes with rams of the coarse-wool breeds, including Lincoln.

TARGHEE RAM weighs 200 pounds, ewe 130 pounds in good range condition. At weaning time, lambs run 80 pounds.

The result was a large crossbred, capable of producing both meat and wool in abundance—provided there was plenty of feed. New Zealand sheepmen developed a Lincoln-Merino crossbred called Corriedale, and Bureau sheep-breeding specialists combined Lincoln and Rambouillet to produce our own Columbia.

But there's a lot of range that isn't luxuriant enough to give these large breeds all the forage they need. Ranchmen found that the best sheep for less productive ranges was a "comeback" strain—made by crossing coarse-wool rams with fine-wool ewes, then mating the crossbred ewes with fine-wool rams. These sheep, bred back to the fine-wool side, have a three-quarters fine-wool and one-quarter coarse-wool inheritance.

But this cross gave ranchmen no rams of an established breed to carry on the type. So, in 1926, the Bureau began at Dubois to lay the foundation for a true-breeding intermediate strain. For 10 years, scientists rigidly selected and interbred rams and ewes from Rambouillet - Columbia and Rambouillet - Columbia - Corriedale combinations. Out of this work came the Targhee, named for Targhee National Forest, where sheep of the new breed grazed in the summer.

Compact and moderately low-set, the Targhee has a broad, level back, good bone, and straight legs. The rump and leg of mutton are well developed. Breeders look for necks without skin folds and open faces free from wool blindness. Ewes shear a heavy fleece with a staple length and fineness much desired by manufacturers. Targhee ewes are good mothers and handle easily.

During the last few years, research men at Dubois have been experimenting with new crosses to improve the Targhee breed. Two combinations—each strong where the other is weak—have been outstanding:

Mating Columbia rams with Rambouillet ewes produced a sheep that scored high in body weight, mutton type, flesh condition, fleece weight, and open face, but only fair in wool-staple length and freedom from skin folds. When Rambouillet rams were crossed with Corriedale ewes, the offspring rated high in staple length, body weight, fleece weight, and freedom from skin folds. However, these sheep scored low in mutton type, flesh condition, and face covering.

By interbreeding the two crosses, or by top-crossing each of them with Targhee rams, breeders at the Dubois station hope they can bring this strong new blood into the breed to improve both its meat- and wool-producing characteristics.

Light juggles atoms to control plant growth

Light-active atoms of plant pigment have been identified as the key to the mystery of how light regulates flowering, seed germination, and many other growth responses of plants.

ARA scientists S. B. Hendricks and H. A. Borthwick reported this development at a recent meeting of the National Academy of Sciences in Washington, D. C.

Work in this field is advancing rapidly. Previous experiments at the Plant Industry Station, Beltsville, Md., have shown that several related growth responses work through a light-absorbing pigment in plant leaves. In recent months, Borthwick and Hendricks have established the properties of this pigment well enough to facilitate its isolation. (Agr. Res., May–June 1953.)

Some of the reactions were known to be photoreversible—they can be moved in one direction by one kind of light, then shifted back by another kind. Red light, for example, makes lettuce seed sprout, but infrared rays hold back germination.

Research now indicates that this happens because both red light and infrared rays can rearrange atoms in the pigment molecule. In one pattern, the atoms control growth; in the other they do not. It's plain that red light shifts the molecule of its growth-controlling form, while infrared rays push it back to the inactive form. A long dark period has the same effect as infrared.

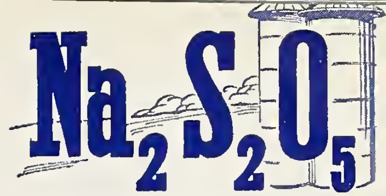
The process has two distinctive features: first, red light or infrared rays can reverse the atom arrangement; second, no other reaction is involved. These features will help chemists isolate the pigment from seed or plants, and recognize the compound once it has been found.

Light-controlled plant responses include bulbing of onions, runner production in strawberries, root formation in corn seedlings, and growth of dark-grown pea seedlings.

Blue-tongue report

In the May–June issue (p. 6), Agricultural Research reported that the virus of blue-tongue disease "has infected some 350,000 sheep in California." The report should have made clear that blue tongue has been diagnosed in flocks totalling about 350,000 sheep, but that not all of these sheep were actually infected. Losses due to blue-tongue disease in California last year are estimated at approximately 15,000 sheep.

Safer treatment for silage:



A new powdered preservative for grass silage has given good results in Bureau of Dairy Industry tests.

Known as sodium metabisulfite, this chemical has the same conditioning effect as sulfur dioxide gas but is safer, cheaper, and easier to apply.

Bureau scientists found that even properly wilted silage was slightly milder and more palatable, and much higher in carotene content, when treated with sodium metabisulfite. Over-all feeding value was about the same on the treated silage, and storage losses were slightly lower.

Application was made with a fertilizer drill attachment mounted over the silage blower. This allowed the salt-like chemical to trickle down on the chopped forage at the rate of 8 pounds to the ton. At 8 cents a pound, sodium metabisulfite costs only about half as much as sulfur dioxide, which is tedious to apply and hazardous for farmers to handle.

The tests were conducted by C. H. Gordon, J. B. Shepherd, H. C. Wiseman, and C. G. Melin. They point out that a green crop turns into silage through a complex process of fermentation in the absence of air. Making good silage requires a heavy growth of the bacteria that produce lactic acid. The result is a clean odor and high nutrient value. Undesirable fermentation, on the other hand, allows free play to the bacteria that produce butyric acid and results in a foul-smelling silage.

Here's where the so-called preservative, or conditioner, can help. Sodium metabisulfite, like sulfur dioxide, combines with the moisture in the crop to make sulfurous acid. This holds down much of the undesirable fermentation in the silage.

Ordinarily, a conditioner is used only in tower silos for three types of high-moisture, high-protein forage: (1) unwilted grass or mixed grass-legume at early head stage; (2) alfalfa or clover alone at all stages through early bloom; (3) soybeans alone at all stages.

A properly wilted crop could be stored without a conditioner, because desirable fermentation takes place naturally when conditions are right. Some farmers, nevertheless, make it a practice to use a conditioner at all times, just for the sake of the added insurance it gives.

Many details of silage making are covered in a new leaflet, "Developments and Problems in Making Grass Silage," which can be obtained from the Bureau of Dairy Industry, Agricultural Research Administration, Washington 25, D. C.

Practical test gives more accurate measure of milk solids

A new way to measure non-fat milk solids promises to help dairymen get greater returns for their milk. Preliminary trials, using a newly designed lactometer and a new formula—plus the regular butterfat test—indicate this method will be practical for use in dairy plants.

With a growing market for non-fat solids, many dairymen question the current practice of pricing milk on butterfat content alone. But they haven't been able to do much about it, since no easy-to-use test for milk solids was available.

Only sure way to determine total solids in milk has been the oven-drying method, a slow laboratory process.

Lactometers, which measure milk's specific gravity, have been used for years to gauge solids content, but their results have not been reliable. ARA dairy chemist Paul D. Watson, who developed the new method, believes one trouble in using old-style lactometers is that tests are made at 60° F. At this temperature, milk fat is partly solidified, which makes readings inconsistent. Also, available lactometers are inaccurately calibrated and too fragile for plant use.

Watson's method involves heating the milk to 102° F.—just above the cow's body temperature—and reading the lactometer at that temperature. With his formula and an accurately calibrated instrument, he gets readings on herd milk that average within 0.1 percent of the oven-drying method. The test is equally reliable with whole milk or with skim milk.

Bureau of Dairy Industry experiments to ready the new lactometer and formula for use in dairy plants are continuing in cooperation with the American Dairy Association and the University of Maryland.

NEW LACTOMETER of aluminum is sturdier than old glass type. Watson uses this instrument to measure specific gravity of milk, maintained at 102° F. by warm water in beaker.

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AGRISEARCH Notes

Ice-fresh sweet corn

State–USDA marketing research is showing sweet-corn growers in the Northeast how to maintain quality in roasting ears, and so avoid price mark-downs that often wipe out profits on this vegetable. New Jersey experiment station studies, for example, demonstrate that packaging sweet corn in wet-strength paper bags with ice can save growers in Burlington County alone a quarter million dollars a year. They can market 52 ears of corn in an iced paper bag for 20 cents, compared to 33 cents for a conventional corn crate or 28 cents for a bushel basket. The iced bags also keep the corn fresher and give it more sales appeal to grocerymen and consumers.

Good turn for fruit packers

With equipment that will turn fruit mechanically as it passes in front of the sorter, packing plants can make large savings in the present labor cost of visual inspection and grading. This basic fact was demonstrated in recent marketing-research studies by the University of California's Institute of Engineering Research in a contract project supervised by the Production and Marketing Administration, USDA.

In most packing houses, sorting is done from conveyor belts that move the fruit with little or no rotation. But in tests on a specially designed grading table, the Institute found that handling required in visual inspection could be sharply reduced if the table rotated the fruit properly as it passed before the graders. Savings in labor costs were 75 percent for lemons and 67 percent for oranges sorted to 3 grades plus culls. Sorting white potatoes to 1 grade plus culls took 15 percent less labor when the potatoes were rotated.

How much packing houses would have to spend to modify or replace their sorting equipment, in order to give proper rotation to fruits and vegetables in grading, has not been established. The cost will undoubtedly be high in many cases. However, visual inspection and sorting accounts for about 25 percent of labor employed by the hour in many packing plants. The savings found possible with improved sorting methods show that changes in present equipment may well be profitable.

Cost saving with cotton

A new kind of cotton bandage, developed at the Southern Regional Research Laboratory, saved the Federal Treasury in 1952 more than $5 million—enough to pay for all the research on cotton done at the big New Orleans laboratory in the past 5 years. The armed services have so far bought more than 13 million of these conformable bandages. They cost about 25 cents each, compared to 62.5 cents for conventional elastic bandages. And the new cotton bandage does a better job. It can be used on elbows and knees without hindering movement, doesn't stop blood circulation, yet won't work loose as the bandaged arm or leg is used. It is made from chemically treated cotton fabric. Development of the bandage took 3 years, cost about $75,000.

Tarnish-proof turpentine

With improved distilling methods and equipment, worked out at USDA's Olustee (Fla.) Naval Stores Station, the gum naval stores industry is now producing turpentine remarkable for its low acid content. This means that today's gum turpentine stays sparkling clear in storage. It has helped pine-gum farmers of the Southeast retain markets, worth more than $1 million a year, that were threatened by darkening of turpentine due to resin acids. The research that led to this latest improvement in pine-gum processing cost about $65,000.

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